Developing Seed Production Areas for Native Plants

Corangamite Region Guidelines

Corangamite Seed Supply & Revegetation Project

Simon Heyes, Michelle Butler, Christine Gartlan & Anne Ovington

CORANGAMITE CATCHMENT MANAGEMENT AUTHORITY

Australian Government

Greening Australia

State Government Victoria Department of Primary Industries

Ballarat Region Seed Bank

Contents

Front cover photograph by Paul Gibson-Roy, Greening Australia Victoria: Leucochrysum albicans (Hoary Sunray) in seed production as part of the Greening Australia Grassy Groundcover Research Project.

Corangamite Region Guidelines

Developing Seed Production Areas for native plants

INTRODUCTION

The establishment of a seed production area (SPA) is a means of collecting increased volumes of indigenous seed for plant conservation and revegetation projects (Flora Bank, 1999).

The following is an outline of the key points of consideration and practical planning tools for establishing a SPA with a focus on the Corangamite region, however some case studies have been used from outside the region to provide practical advice. All the recommendations are reflective of current knowledge and experience and are founded on the Flora Bank Guideline 7 - Seed Production Areas for Woody Native Plants as well as numerous literature searches, personal accounts and projects.

What is a Seed Production Area (SPA)?

The term 'seed production area' refers to plants established to produce seed that is as representative of an original, healthy wild population as possible. A SPA is established using known seed sources and planted in a design that will maximise the potential for cross-pollination, while also providing easy access for collection and maintenance. The SPA should be designed to maintain genetic diversity of the source population, while also providing a buffer for local remnant vegetation from fragmentation issues, while also adding to the conservation of a species (Butler 2007).

Why establish a SPA?

The increased use of direct seeding techniques in the revegetation industry has created a demand for diverse, provenance based indigenous seed. Seed is currently supplied foremost from roadsides and private property. With a high demand and seasonal impacts causing poor or reduced seed set, supply is often limited and labour intensive to collect. Collection often needs to be timed carefully to capture seed from some species which may drop seed quickly.

General seed collection in remnants can impact on

- the soil seed bank, limiting the capacity for natural regeneration,
- the flowering potential of plants through foliage removal, which in turn can affect future seed supply,
- food sources for native fauna,
- the health of plants through damage to branches and heartwood which can allow infection and disease to spread.

Whilst seed produced from SPA's can decrease some of the pressure on remnant populations, additional collection from wild populations will still be a requirement to ensure the genetic quality and species diversity is maintained from seed production areas.

A SPA is designed so that seed can be more easily harvested in large enough quantities to supply local requirements, while also overcoming environmental factors such as lack of moisture availability, nutrients or competition that can affect seed yield (Paul Gibson-Roy *pers comm.*).

SPA Planning

In establishing a SPA there needs to be a solid commitment from the land manager, a set purpose for the seed as well as a plan for who collects and owns it. Ongoing maintenance is often under estimated and can make or break a carefully planned seed production area. Management and maintenance is important to the long-term capacity of the SPA and management and maintenance agreements may need to be

in place before any work is undertaken.

Seed Production Areas can be a lot of time and energy.

Key considerations include the:
- long term commitment from land managers
- land tenure security for at least 5-10 years, depending on the type of SPA
- good planning and preparation including an understanding of plant species, growing & seed setting requirements
- purpose of the seed and an understanding of seed supply needs in an area
- collection and ownership agreements
- on-going maintenance and record keeping requirements
- site design, size and access requirements
- availability of appropriate seed sources

Setting the objective
Seed production areas are encouraged as a source of indigenous seed that may not be readily available or difficult to collect in the environment but that can be propagated easily. A SPA may also be able to produce for alternative markets such as foliage, flowers and bush food. The focus is on establishing sites to remove seed collection pressure from precious remnants for large revegetation efforts, but alternative uses are worth bearing in mind when seed needs change from season to season.

Species Selection
Whilst the initial focus of seed production areas has often been on difficult to collect or fragmented species that require conservation, there is also a need to increase supplies of seed for key 'structural' species used in revegetation activities including direct seeding. SPA's also offer a means to supply seed from the wide range of species that may be needed for restoration of a specific plant community (Paul Gibson-Roy, *pers comm.*).

Concentrate on producing seed for a few key species that are needed for local revegetation projects.
- Check how rare or fragmented populations are in the landscape.
- Check that there is appropriate seed sources or plant material available to start a SPA.
- Find out what time of year seed for a particular species can be collected.
- Be aware of conditions for collection and permit requirements. Check if a permit can be obtained to collect particular species.

Research species to find out:
- Plant growing conditions
- Plant size at maturity for spacing to ensure ability to harvest seed from around the plant
- Plant reproduction—are separate male and female plants required or are flowers complete or separate on a single plant? The design needs to ensure that cross-pollination is maximised.
- Pollination mechanism (wind, birds, insects), pollinator availability and needs
- Longevity of plant, seed yields and time to seed set
- Potential risks for hybridisation between closely related species and subspecies
- Species reliability in the nursery or in direct seeding—ease of propagation and propagation techniques
- Harvesting techniques
- Sowing requirements—is fresh seed needed or can it be stored for later use? Does it need pre-treating or does it have a dormancy period?

SPA genetics

Genetic diversity is maintained by using seed from as many parent plants in the source provenances as possible. Note that this is different from a seed orchard which is established to produce seed that has been improved through selective breeding for a particular trait such as the forestry or flower production industries (Butler 2007). In forestry, plant genetics has been a focal point for industry development and considerable time and resources have been invested over a number of decades to genetically strengthen plants and to breed for particular species' traits such as straight trunks and fast growth.

The consideration of genetics for seed production areas focuses on retaining the genetic diversity and characteristics of populations rather than selecting and enhancing favourable characteristics. The genetic quality

of the produced seed is far more important than the actual quantity produced. Genetic diversity is maintained by using seed from at least 10 to 20 widely spaced healthy parent plants (Prober & Brown 1994; Flora Bank 1999).

The introduction of plants from hybridised populations or plants with the potential to hybridise with nearby populations should be considered very carefully. Past research has shown that some hybridised *Eucalyptus* species have reduced levels of survival, seed viability and genetic fitness (Lopez *et al.* 2000; Drake 1981), while some *Acacia* species are also said to hybridise with introduced species such as Cootamundra wattle (Spencer 2005). This may affect not only seed yield but also has the potentially to affect seed viability and the fitness of local plant populations.

It is also important to 'refresh' the SPA with new individuals every few years to invigorate genetic quality of the seed, so as not to perpetuate a narrow genetic base in the seed supply chain. The Grassy Groundcover research project has plants in production from 2 - 4 years, with many of the forbes only being in production for 2 years, while grasses are often in production for up to 4 years (Paul Gibson-Roy, *pers comm*).

Seed collection from source populations
Source populations are extremely important. Unless the parentage diversity of a revegetation site is known, it is advisable to collect only from remnant vegetation sites.
Some important factors to remember when collecting seed include:

- Planning 12 months to 2 years ahead to source appropriate seed
- Visit sites several times a year or over consecutive years to collect seed if possible and mix the seed from different years.
- Collect seed from large, healthy remnant populations of at least 100 to 500 reproductive individuals (Buza *et al* 1999; Prober & Brown 1994, Broadhurst 2007).
- Where populations are fragmented, pool fragmented populations together from similar environments to improve the genetic base to reduce the possibility of any inbreeding issues. Collect seed from at least 3 to 5 locations of similar climate and soil (Bonney 2003), while attempting to concentrate on the larger populations as your basis for the SPA.
- Collect seed from as many parent plants as possible, while covering the extent of the population, ideally 50-100 individual plants.
- For species that were once part of continuous populations prior to vegetation fragmentation, collect from at least 10 plants covering the extent of the remnant populations to maximise genetic diversity from across the populations (Prober & Brown 1994).
- Collect small amounts from around the whole canopy of each plant and from as many fruit as possible to avoid seed from closely related pollen parents (Muona et al 1990).
- Choose from individual plants randomly and at distance so as not to collect closely related individuals or clonal suckers, such as Blackwood (*Acacia melanoxylon*) and Sweet Bursaria (*Bursaria spinosa*).
- For general seed collection parameters refer to:
  Flora Bank Guidelines № 5 (http://www.florabank.org.au)
  Defining Seed Collection Ranges for Indigenous Plants (http://www.ccma.vic.gov.au).

Collection of non-seed based plant material
Cuttings can be used from parent plants in declining remnants or highly degraded plant communities, where the parent plants have greater genetic diversity than the seed that they produce (Flora Bank 1999). However be aware that plant propagation methods such as taking cuttings or dividing rhizomes or roots produce exact genetic clones of a plant. Plant material is generally only used for conservation or when seed collection from wild populations is limited and this should be combined with plants from other populations to reinvigorate the gene pool.

Design features

The design should maximise cross pollination between plants within the seed production area. Linear designs such as windbreaks may lead to preferential pollination or in the case of wind pollinated species, pollination may occur down wind from a single or a few pollen parents. Research indicates that plants in linear strips receive less pollen and this leads to lower fruit and seed set (Cunningham 2000). This could affect yield potential and genetic diversity of produced seed. Block planting is recommended and should maximise the chances for random cross pollination, creating higher genetic diversity and improved yields.

Harvesting should be taken into account in the planting design. Large trees may require block plantings spaced

up to 15 metres apart so that the whole canopy of each tree can be accessed by collectors and vehicles. Coppicing of particular tree species may be an advantage for improving access and seed set. However some large trees such as she-oaks are not suitable for coppicing. For smaller plants, the 'strawberry grower plot' design is worth considering - mounds of earth are made 3-5 metres apart and covered with weed mat with ditches or seed traps between each mound to catch seed when it ripens (see Case Study 2). This design allows for easier seed collection, especially for successionally ripening species such as Chocolate Lilies, Bulbine Lilies and some bush peas. Drip watering systems can also be included to improve plant survival during dry periods and maintain a steady seed yields.

How many plants?
For a strong genetic base, a minimum of 100 plants should be established for each species. At least 10 seedlings should be raised from each of the original parent plants and mixed in a block planting to maximise genetic quality of the seed (Flora Bank 1999).

It is also important to have an idea of how much seed is required each year for projects. Estimate the yield of seed for each plant and use this to estimate the number of plants required in the SPA to meet seed supply demands.

A two year time-frame may be needed for supplementary seed collection, propagation and planting due to plant losses from drought, pests or disease.

Layout
Develop a layout plan and map of the location of planted species and keep records of number of source plants, provenance, dates plants were collected and any replacement plants. Label each block or row with wooden stakes or aluminium tags that will withstand the elements (Flora Bank 1999; Bonney 2003). Layout plans assist with the replacement of both labels and replacement plants. Records should also be kept on seed yields and flowering periods (see Appendix).

Site selection
If locally sourced seed is used for a SPA and the species chosen do not pose a hybridisation risk to wild sites, then locating the SPA near a remnant population is ideal. This will allow a link to pollinators such as birds and insects that will facilitate cross pollination and increase the genetic quality of seed. This can also provide protection from winds and extreme weather and provide a buffer for the remnant for longer term fecundity, but this may also pose an increased risk of predation from native and introduced pest animals.

Ongoing access and all weather access to vehicles is important for harvesting and maintenance.
The site should be as large as possible. The example in Table 1 is a rough guide of the area required for different plant forms. Access between rows for harvesting equipment and vehicles needs to be considered in space

TABLE 1 - GUIDELINES FOR SPACING OF PLANTS WITHIN A SEED PRODUCTION AREA

100 plants in a block	Spacing between plant canopies				
Plant form	0.5 m	2 m	3 m	5 m	10 m
Large tree with a canopy of 10 metres	1.1 ha	1.4 ha	1.7 ha	2.3 ha	4 ha
Large shrub with a canopy of 5 metres	0.3 ha	0.5 ha	0.6 ha	1 ha	2.3 ha
Medium shrub with a canopy of 2 metres	0.06 ha	0.16 ha	0.25 ha	0.5 ha	1.4 ha
Grass or groundcover with a cover of 1 metre	0.02 ha	0.09 ha	0.16 ha	0.36 ha	1.2 ha

calculations.

Maintenance

The following maintenance tasks may need to be implemented at various stages of the SPA lifespan and need to be considered in the planning stage to ensure budget, commitment and resources are available.

Pruning
Plants may need to be tip or branch pruned to ensure easy seed access, increased light exposure, promote new growth and potentially increase seed yield. Pruning may be structured around seed collection to minimise time spent on SPA maintenance.
Woody species may also benefit by being espaliered or fan trained to improve seed access and fruiting potential. They may also need regular pruning and training to improve harvesting access and yield. This is often done during harvesting to save time.

Plant replacement
Plants may need to be introduced in the later years to replace damaged or dead plants or to reinvigorate the genetic quality of produced seed.

Weed & vermin control
Pests such as rabbits can be reduced before the site is planted by implementing control programs. Follow-up may be required and regular visits to the site to check for signs of damage is advisable. Netting fencing or tree guards may be required.
.
Sign and label replacements.
Names and dates engraved on to metal labels and tied with wire to star pickets are a long lasting example. Check any labels or signs for fading and use an original planting map as a guide to confirm tags location.

Watering
Supplementary watering may be required during extended dry periods, especially during plant establishment.

Seed Harvesting

For many Australian species, such as wattle or hop bush, seed ripening and maturity occurs in the summer months, while extended hot dry periods can hasten the rates at which the fruit and seed ripens. Therefore the ability to access the site easily and at short notice to collect seed or monitor its progress is extremely important. It is also important to understand the life cycles of the species that are in production, to enable the site manager to implement appropriate seed collection, pruning and pest control regimes.

Seed collection techniques currently used in seed production areas can range from the standard techniques of pruning to remove seed laden branches on woody species or hand collecting ground cover species with secateurs or scissors.

Some of the more innovative methods suggested and currently being used include:

Bandicoot Native Grass Seed Harvester
A native grass seed harvester is a portable and easy to use brush harvester that can be towed behind a 4WD vehicle. It has an adjustable draw bar that enables the machine to be towed on the right hand side of the vehicle. The Bandicoot also has a stiff harvesting brush that is powered by a simple petrol motor. The harvesting brush is also adjustable, meaning it can be raised or lowered to the correct height of the grass seed heads. The machine brushes and seed hopper require thorough cleaning before and after use to prevent seed contamination.

Brush Cutters
These can also be used to harvest a range of grasses and ground cover species but their efficiency can be considered more variable (Atkinson *pers. comm.* 2008), while the risk of contamination with weed seed is still high.

Olive & Grape Harvesters
Olive and Grape harvesting machines may be an option to quickly harvest non-persistent seeds from woody plants, such as wattles, hop bushes and some larger members of the pea family. Olive and Grape Harvesters are ideal for larger areas that require considerable time and labour during harvest time. This method is currently being considered in North East Victoria and has not yet been trialled.

Seed Traps

Mounded rows with seed traps (ditches) are covered with weed matting to provide a clean surface for seed collection (Vanzella 2008; Mann *pers. comm*. 2007). These can be used to collect and harvest seed of smaller shrubs and ground covers that have non-persistent seed (see Case Study 2), while also providing weed suppression. The seed can then be swept up with a small brush and shovel or vacuumed using a hand vacuum.

Hand Collection
This method is best suited to woody species with persistent fruit types, such as tea-trees, paperbarks, eucalypts, hakeas and some wattles. Hand collection may also be used with some members of the daisy family, where the removal and drying of seed heads is required to extract seed. Most hand collection can be done with some of the following equipment:

- Good quality secateurs or anvil pruner
- Tarpaulin sheets to use during harvesting and subsequent drying
- Long handled pruning saw or loppers
- Hard hat, safety shoes and thick gardening or builders gloves
- Feed bags or wool bales used to store fruit/seed material during harvesting and transportation

***Acacia* (Wattles):** *Acacia* seed is held in a pea-like pod that will often become brown, dry and brittle when mature, while the seed becomes dark brown or black. The pods can be harvested by pulling or shaking them by hand into a bag or kidney tray. With thorny or tall *Acacia* species, tarpaulin sheets can be placed under the plants and the plants shaken by hand or with a long handled pruner to remove the pods and seed. Some *Acacia* species, such as Blackwood (*A. melanoxylon*) or Lightwood (*A. implexa*), may require pruning to remove pods, while the pods will then need to be threshed to remove seeds that are attached by fleshy funicles. The cleaning of *Acacia* seed can then be done with sieves or vacuum boxes to remove un-wanted pods, leaves and dust. (*Note: Some wattle seed and pods can cause allergic reactions and asthma. Dust masks, eye protection and gloves should be worn when cleaning or handling seed*)

Myrtaceae (*Eucalypts*, Tea-trees, Paperbarks, Bottlebrushes): Most members of the Myrtaceae family have persistent or semi-persistent woody fruit, with some exceptions, such as River Red Gum (*E. camaldulensis*), Burgan (*Kunzea ericoides*) or Silky Tea-tree (*Leptospermum myrsinoides*). Therefore much of the collection will need to focus on removing the woody fruit and drying them to extract the seed. Most *Eucalypts* are tall trees, therefore long handled pruning saws or loppers will be needed to access higher fruit laden branches, however most tea-trees, paperbarks and bottlebrushes can be harvested by hand with a set of secateurs or anvil pruners. Once fruit has been removed in a safe manner, they should be laid out in a dry warm place to open the valves of the woody fruit and extract the seed. The seed of most Myrtaceae can then be cleaned with a set of graded sieves to remove woody material and leaves. *Eucalyptus* fruit are often filled with red or orange chaff and doesn't need to be cleaned further.

***Allocasuarina* (She-oaks):** *Allocasuarina* seed, also known as samara, is a winged seed held within a large woody cone that is usually found along the older stems of female plants. The cones are persistent and should be brown or grey in appearance when mature. The cones should be harvested by hand by knocking cones off the branches, not by cutting branches. Once the cones have been removed the seed can be extracted in a dry warm place. Place cones on a mesh frame to extract seed with minimal cleaning.

Hakea: *Hakea* belong to the Proteaceae family, which also includes members, such as *Banksia*, *Grevillea* and *Lomatia*. *Hakea* have a papery winged seed held within a woody fruit called a follicle. The follicle is quite persistent and will remain unopened on the parent plant for several years. The follicles should be carefully harvested by hand using secateurs to remove branches or individual follicles, although harvesters should wear gloves, thick long sleeved clothes and eye protection when collecting from the prickly leaved species of *Hakea*. The follicles can then be dried in a dry warm area to extract the seed. Once extracted seed can be cleaned using graded sieves or vacuum box.

Record Keeping
Once seed has been extracted and cleaned, the next important step is to ensure that seed details are recorded for use by the seed bank or project officer. Keeping records is an essential component of seed collection of a SPA. It is important to record as much infield data as possible and field data sheets, such as those used by Ballarat Seed Bank (see Appendix), are ideal for this. Such records allow seed banks and project managers to track the source of seed produced from the SPA and seed collected for the SPA. It is also very important to keep records for the seed that was collected for the establishment of the SPA, what was collected, when, number of parent plants storage and where it was collected.

Case Study 1

Grassy Ground Cover Project

Grassy Ground Cover SPA managed by Andrew Wolstenholme at the Maffra Seed Bank (Photo A. Wolstenholme 2007)

The Maffra seed production area is located at the Maffra Seed Bank in Central Gippsland and is managed by Greening Australia in Gippland. The SPA was established to aid the supply of seed for the re-establishment of three hectares of native grassland in Central Gippsland as part of the Grassy Groundcover project. The species chosen either proved difficult to collect large volumes or the natural seed production is limited by environmental factors (Paul Gibson-Roy *pers comm* 2007). All plants are local to the area. The boxes were placed on pallets to provide drainage and spaced 2 metres apart for easier harvesting. Fencing was then constructed around the compound to reduce the effects of wind, keep out weed seed and prevent rabbits from destroying plants. Part of the fence was made out of shade cloth while the rest is a paling fence. The production area was constructed in May – June 07 while the seed to grow the plants was collected in the previous summer and grown in the autumn. Maffra Seed Bank harvested the seed in summer 2008 and direct sow the seed for revegetation the following autumn.

Species grown include:

- *Acaena ovina* Australian Sheeps Burr
- *Arthropodium milleflorum* Pale Vanila-Lily
- *Bulbine bulbosa* Bulbine lily
- *Craspedia variabilis* Common Billy Buttons
- *Dichelachne crinita* Long-hair Plume-grass
- *Elymus scaber* var. *scaber* Common Wheat-grass
- *Linum marginale* Native Flax
- *Microseris lanceolata* Yam Daisy
- *Glycine clandestina* Twining Glycine

- *Chrysocephalum apiculatum* Common Everlasting
- *Stylidium graminifolium* Grass Triggerplant
- *Senecio spp* Fire weeds
- *Wahlenbergia spp* Blue Bells
- *Xerochrysum viscosum* Sticky Everlasting

The plants are grown in polystyrene containers with 8 – 30 plants per box and will be replaced after 2 years to increase the gene pool of the seed being collected from the seed production area. The seed is collected by hand by seed collectors that are employed casually over the summer months. The seed is then stored in the seed bank until autumn sowing. The plants are watered with a drip irrigation system with a manual timer during the drier months to ensure plant survival. Maffra Seed Bank manager Andrew Wolstenholme (pers comm.) suggests that this may need replacing with automated timers if the seed production area is expanded.

One of the major issues that this seed production area has faced is local water restrictions. This delayed the potting up of seedlings and as a result some plants may not flower or seed in the first season. This may be overcome by growing plants on at nurseries with water rights.

The cost of the Maffra SPA per year is said to be approximately $7300 to set up 288 polystyrene boxes, including labour and collection costs.

Case Study 2

Euroa Arboretum Seed Production Area

Euroa Arboretum Seed Production Area (Photo J. Begley, DPI 2006)

The Euroa SPA was set up in 2005 by Sally Mann at the Euroa Arboretum to address the shortfalls in seed supply of smaller ground cover species that could be direct seeded easily. These species often proved to be difficult to collect in the wild or in a 'bush' seed production area due to sequential ripening, prostrate habit or non-persistent seed that opens without warning in hot dry weather.

- *Glycine tabacina* — Variable Glycine
- *Pultenaea williamsonii* — Williamson's Bush Pea
- *Templetonia stenophylla* — Leafy Templetonia
- *Einadia nutans* — Climbing Salt Bush
- *Chenopodium desertorum* — Frosted Goosefoot
- *Desmodium varians* — Slender Tick Trefoil

The Seed Production Area was designed with seed traps that collects the seed in specially designed ditches that enable easy access and collection for species that ripen sequentially.

Plants were established on mounds spaced 3 metres apart, using a machine called a delver to form ditches. Boards were then inserted into ditches to act as a separator within the ditches between seed of different species. All ditches, mounds and boards were covered with weed cloth to provide low maintenance weed control. A drip watering system has been introduced to keep plants watered during dry periods. Fencing was also set up to prevent native and introduced animals from entering the compound and consuming plants. Windbreaks using *Hardenbergia violacea* (Purple Coral Pea) will be introduced on to trellises and will also be harvested in the future.

Once seed is ripe it falls into the ditches, where predation by ants was said to be a problem, but easily overcome by regular harvesting of seed from the ditches using a soft bristle broom to sweep up the seed. Initial harvesting used a small vacuum cleaner but proved too difficult due to the time consuming effort of removing seed from the vacuum dust bag. Estimated material and equipment cost was around $6000 which was sourced from grants, while labour costs during the planning and construction of the SPA is estimated to be between $20,000 - $25,000.

Case Study 3

Inverleigh SPA

Inverleigh SPA - site boundary in yellow. Map: I. Shurvell, DPI 2006.
Inset: Drought conditions during the year of planting resulted in some losses. Photo: Nov 2006 M. Butler. DPI

Located on the floodplain of the Leigh River at Inverleigh, this SPA was planned by the Geelong Landcare Network in 2004 with assistance from the Corangamite Seed Supply and Revegetation Network. The site is public open space and links to a large block of riparian vegetation that may introduce insect and bird pollination to the site. The SPA was planted in spring 2006 for future seed supply to local revegetation projects. Species were chosen based on the local demand for seed, and to compensate for difficulties with collecting from wild populations due to low fruit set, non-persistence of seed or fragmentation of sites.

Species grown include:

- *Leptospermum continentale* Prickly Tea Tree
- *Dodonaea viscosa* Sticky Hop Bush
- *Bursaria spinosa* Sweet Bursaria
- *Banksia marginata* Silver Banksia
- *Acacia dealbata* Silver Wattle
- *Eucalyptus leucoxylon* subsp *connata* Yellow Gum
- *Callitris columellaris* Native Cypress Pine

The seed was collected from local provenances with 1600 seedlings that were then raised by the local nursery. The site was fenced and planted by a Greencorp team. Plants were guarded against rabbits. Funding from the Corangamite Seed Supply and Revegetation Network covered fencing materials at a cost of $630, tree guards and stakes at $670 and seed collection and nursery costs at $1120.

Planning and effort focused on species selection, spacing guidelines, site preparation and sourcing seed from a high number of parent plants. All species were sourced from a minimum of 10 to 50 parent plants. Initial weed control on this site was excellent but constant dry conditions became an issue. There were a number of losses to Prickly Tea Tree and Sticky Hop Bush during the summer of 2006/2007. This may have been overcome with watering during the dry months had have been available, however the lack of clear management agreements made this difficult. Supplementary planting has been recommended by the Corangamite Seed Supply and Revegetation Network and a site visit in 2007 found that a spring flush of weedy grasses (such as *Phalaris)* was out-competing the remaining seedlings. This highlights the need to dedicate maintenance time and labour resources to a site in an ongoing capacity. Clear management agreements that indicate responsibilities may also be needed to then allocate tasks to individuals within the group or to seek additional funding to supply contractors in an on-going capacity for maintenance activities.

APPENDIX

Seed Production Area Planner

Year	Tasks	J	F	M	A	M	J	J	A	S	O	N	D
1	Identify local need for SPA – species & provenances												
	Identify sites for SPA												
	Determine costs, acquire funds if applicable												
	Design planting lay out, including plant numbers and seed requirements												
	Plan and undertake seed collection activities – determine species and locate remnants for collection	**x**	**x**	**x**	x	x	x	x	x	x	**x**	**x**	**x**
	Seed collection – source populations *	**x**	**x**	**x**	x	x	x	x	x	x	**x**	**x**	**x**
	Document all seed sourcing	x	x	x	x	x	x	x	x	x	x	x	x
2	Seed collection – source populations *	**x**	**x**	**x**	x	x	x	x	x				
	Plant propagation **									x	x	x	x
	Site preparation (weed control and ground preparation)					x	x		x	x			
	Planting according to plant layout								x	x	x	x	
	Erect signage to recognise SPA and denote individual species								x	x	x	x	
	Maintenance weed control (spray or slash)					x	x		x	x			
3	Seed collection from SPA****, take all available, record weights	**x**	**x**	**x**	x	x	x	x	x	x	**x**	**x**	**x**
	Maintenance check plant survival replace as necessary*** remove tree guards weed control (spray or slash), including between rows pruning tip or branch								x	x	x	x	
	Replanting of non survivors								x	x	x	x	
	Assess seed availability and collect what is available												
	Seed collection - SPA****	**x**	**x**	**x**	x	x	x	x	x	x	**x**	**x**	**x**
4-10	Maintenance weed control pruning Seed Collection - SPA****	 x **x**	 x **x**	 x **x**	 x	 x x	 x x	 x	 x x	 x x	 **x**	 **x**	 x **x**

* seed collection timeframes will depend on the species selected for the SPA. Collection may need to be extended depending on seed availability
** whilst the majority of plants can be propagated in spring, there are a number of species can be slow growing or need to be propagated at another time
*** ensure that replacement stock is of the same integrity as original source populations
**** species dependant but mostly from December to February. Bold **x** denotes peak seed collection times

Seed collections marked in blue.

Ballarat Region Seed Bank

Seed Production Area,

Revegetation Site or Plantation

Original Seed Source Information

To ensure the integrity of seed supplied to Ballarat Region Seed Bank and consequently our clients and revegetation programs, seed from Seed Production Areas (SPA), revegetation sites or plantations requires additional information. We need to know about the original seed source used in its establishment. We require you to fill out the details below.

FloraBank

	BRSB site registration no.:
	Original batch no. (BRSB No. if applicable):
	Date site established: …….day …….month …….year
Original seed source collection site name:	**or Latitude:** …….º ……’ ……” South
Original seed source collection location/town:	**Longitude:** …….º ……’ ……” East

Original tenure: *please circle*

Roadside Private Land Public Land

State Forest Reserve Waterway Unknown Other ……..

Original vegetation community (e.g. BVT or EVC) :	

Plant form: *please circle*

Tree Shrub Understorey Sedge Grass Other ……

No. of Plants Collected from? *please circle* Specify b/w 1-10 …… 11-25 26-50 50-100 100+	**Population Size:** *please circle* Specify b/w 1-10 …… 11-50 51-100 101-500 500+
Geology:	
Other information:	

Glossary

EVC - Ecological Vegetation Class is defined by a combination of floristic, lifeform and position in the landscape. Each EVC includes a collection of floristic communities (ie groups based on co-occurring plant species) that occur across a biogeographic range, and although differing in plant species, have similar habitats and ecological processes (DSE 2007).

EVC Benchmark - Developed as standard vegetation-quality reference points that are applied in carrying out vegetation quality assessments. Represents the average characteristics of a mature and apparently long-undisturbed stand of the same vegetation type (DSE 2007).

Genetic Diversity - The extent of variation in a population, or species, or across a group of species (Frankam et al 2002).

Hybrid - Offspring of a cross fertilization by parents with different genetic systems (Debenham 1971).

Hybridisation - Production of hybrids from either different species or individuals of the same species and may lead to ultimate divergences from the parental form (Debenham 1971).

Inbreeding - Production of offspring by related individuals eg self fertilisation, brother X sister and cousin matings. Characteristics reduced or affected by inbreeding include pollen quantity, number of ovules, amount of seed, germination rates, growth rates and competitive abilities (Frankham et al 2002).

Indigenous - Indigenous often refers to a plant or animal that originates from a particular area or region and is thus native to that site. For the purposes of these notes, indigenous refers to plant species that occur naturally in the Corangamite region at particular localities. For example, *Hakea decurrens* is a native plant of the Corangamite region but is only indigenous to the northern part of the catchment.

Provenance - The Geographic origin or source of the seed (Debenham 1971). An area where a species is found naturally, showing variation from the same species found in other locations. It may appear physically different or perform differently from seed or plants from another location of the same species.

REFERENCES

Bonney N (2003) What Seed is That? A guide to the identification, collection, germination and establishment of native plant species for central Southern Australian landscapes, *Finsbury Green Printing*, 2nd Edition

Broadhurst L (2007) Managing genetic diversity in remnant vegetation Technical Note 01/2007 L&W Australia

Butler M (2007) Seed Production Areas in the Corangamite Region, Unpublished DPI report for the Corangamite Seed Supply and Revegetation Network.

Buza L, Young A & Thrall P (2000) Genetic erosion, inbreeding and reduced fitness in fragmented populations of the endangered tetraploid pea *Swainsona recta,* Biological Conservation, Vol. 93, pp 177-186

Corr K (2003) Revegetation Techniques: A Guide for Establishing Native Vegetation in Victoria, *Greening Australia*

Cunningham S A (2000) Depressed Pollination in Habitat Fragments Causes low Fruit Set, *Proceedings of The Royal Society B***,** 267, pp 1149-1152

Debenham C (1971) The Language of Botany, *The Society for Growing Australian Plants*, 2nd Edition

Drake D W (1981) Reproductive Success of Two Eucalyptus Hybrid Populations. I Generalized Seed Output Model and Comparison of Fruit Parameters, *Australian Journal of Botany*, Vol. 29, pp 25-35

DSE (2007) Online Native Vegetation Glossary, DSE, <http://www.dse.vic.gov.au/>

FloraBank (1999) Guidelines 5 Seed Collection from Woody Plants for Local Revegetation, *FloraBank*, <http://www.florabank.org.au/>

FloraBank (1999) Guidelines 7 Seed Production Areas for Woody Native Plants, *FloraBank,* <http://www.florabank.org.au/>

FloraBank (2000) Guidelines 10 Seed Collection Ranges for Revegetation, *FloraBank*, <http://www.florabank.org.au/>

Frankham R, Ballou J D & Briscoe D A (2002) Introduction to Conservation Genetics, *Cambridge University Press*

Lopez G A, Potts B M & Tilyard P A (2000) F_1 hybrid inviability in *Eucalyptus*: the case of *E. ovata* x *E. globulus*, *Heredity*, Vol. 85, pp 242-250

Muona O, Moran G F & Bell J C (1990) Hierarchical Patterns of Correlated Mating in *Acacia melanoxylon*, *Genetics*, Vol. 127, pp 619-626

Prober S M & Brown A H D (1994) Conservation of the Grassy White Box Woodlands: Population Genetics and Fragmentation of *Eucalyptus albens*, *Conservation Biology*, Vol 8, №. 4, pp 1003-1013

Robinson J (2008) Bandicoot Native Grass Seed Harvester - Standard Operating Procedure, *Greening Australia*

Spencer R (2005) Environmental Weeds, Agricultural Weeds and Garden Plants: resource and information pack with emphasis on Victoria, *Royal Botanical Gardens Board*

Vanzella B (2008) Introducing Seed Production Areas: An Answer to Native Seed Shortages, *Greening Australia*

ACKNOWLEDGEMENTS

Information compiled for this note series was a result of extensive literature reviews, plant record searches and personal communications completed by Simon Heyes, Michelle Butler, Christine Gartlan and Anne Ovington

Personal Communications and Contributions:
Andrew Wolstenholme, Maffra Seed Bank, Maffra 2007
Paul Gibson-Roy, Grassy Groundcover Project Leader, Melbourne 2007
Sally Mann, Euroa Arboretum, Euroa 2007
Jim Begley, DPI 2007 & 2008
Penny Atkinson, Florabank, Canberra 2008

To contribute to or provide feedback on this note, please email the Corangamite Seed Supply and Revegetation Network Coordinators:

Michelle Butler, Department of Primary Industries michelle.butler@dpi.vic.gov.au
Simon Heyes, Greening Australia (Vic) sheyes@gavic.org.au
Anne Ovington, Ballarat Region Seed Bank anne.ovington@dpi.vic.gov.au